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(71) Applicant(s)

Vodafone Limited
(Incorporated in the United Kingdom)
The Courtyard, 2-4 London Road, NEWBURY,
Berkshire, RG13 1JL, United Kingdom

(72) Inventor(s)

Chris Haynes
Phil Carter

(74) Agent and/or Address for Service

Mathisen Macara & Co
The Coach House, 6-8 Swakeleys Road, Ickenham,
UXBRIDGE, Middlesex, UB10 8BZ, United Kingdom

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(54) Abstract Title

Method of Providing Access to First and Second Communication Networks

(57) A GSM cellular telecommunications network arrangement comprises mobile switching centres (MSC 8A,8B,8C) controlling base stations (14) defining cells (16) forming respective geographical areas (18A,18B,18C). To provide increased coverage, a satellite communication network (30,32) is also provided, of which at least some of the subscribers ("dual-mode subscribers") are also subscribers to the GSM network arrangement. A registration request from an MTU (17d) operating in the satellite network is received by an MSC (8D). It is passed to an access node (40). This carries out a check to verify whether the subscriber making the request is in fact a dual-mode subscriber. Only requests from dual-mode subscribers are then passed to the appropriate HLRs (22A,22B,22C) to initiate the registration and authentication process which is carried out otherwise than through the access node (40). The HLRs (22A,22B,22C) therefore do not have to be modified in any way to check for dual-mode subscribers; this checking is carried out by the access node (40).

The second network may also be a WLL, a banking service network, or a second cellular telephone network.

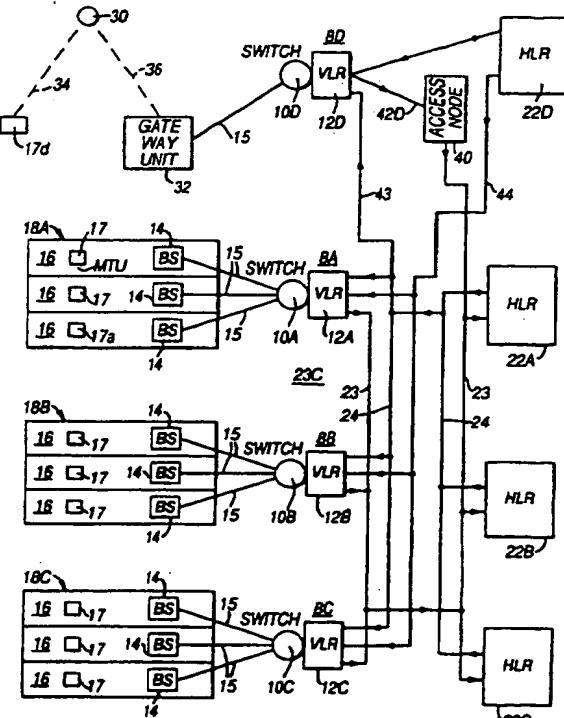


Fig. 1

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1/4

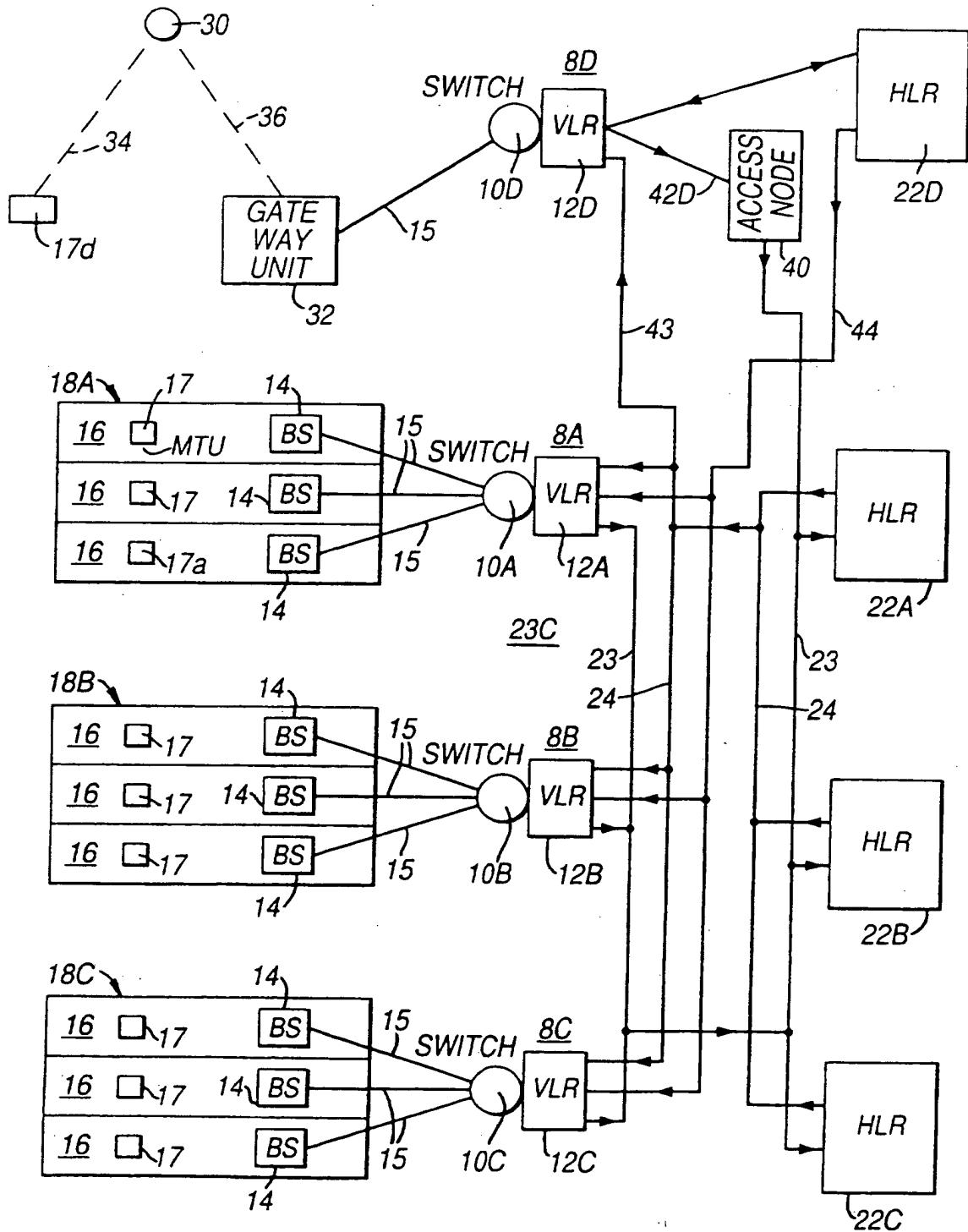


Fig. 1

2/4

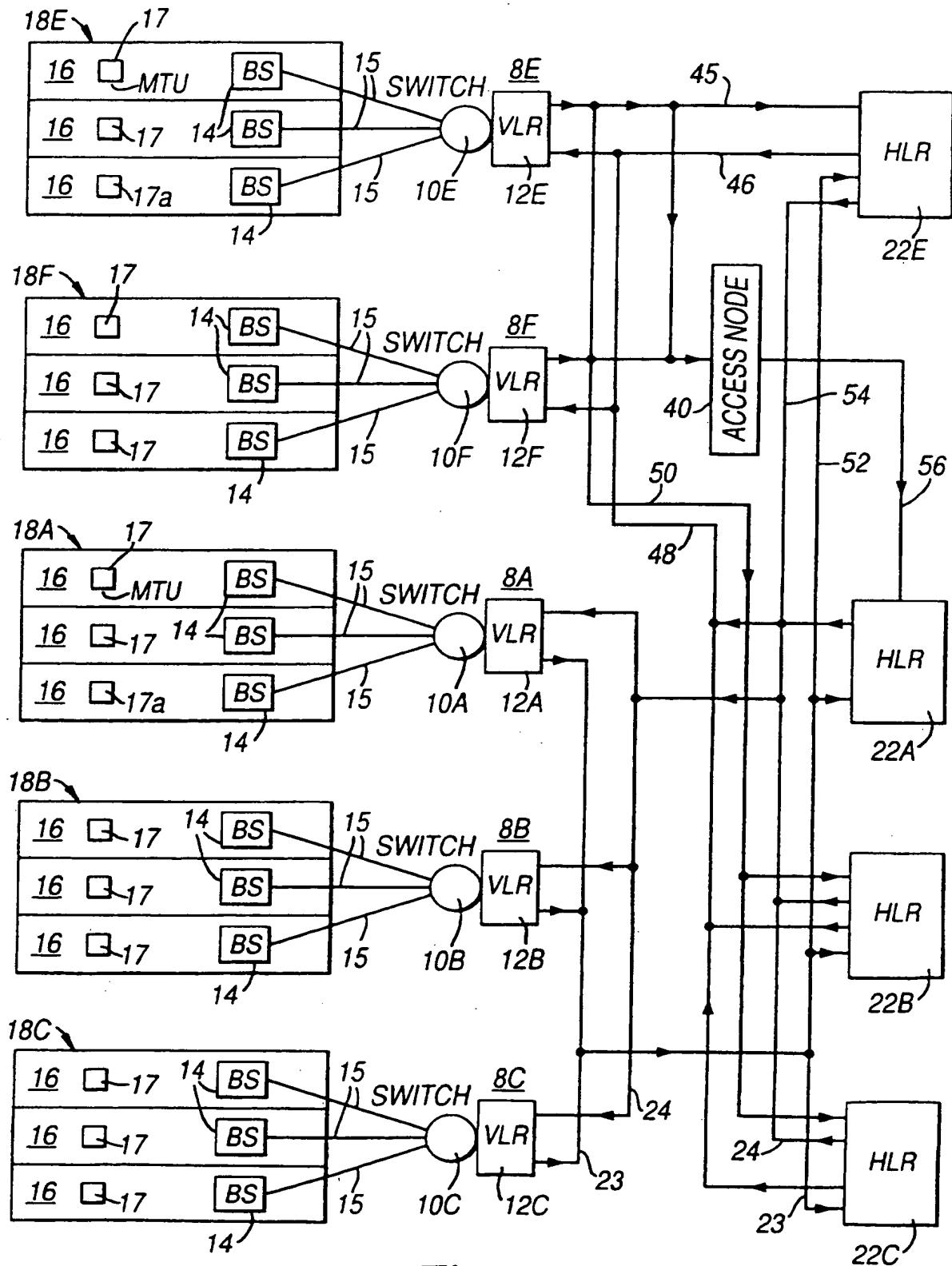


Fig. 2

3/4

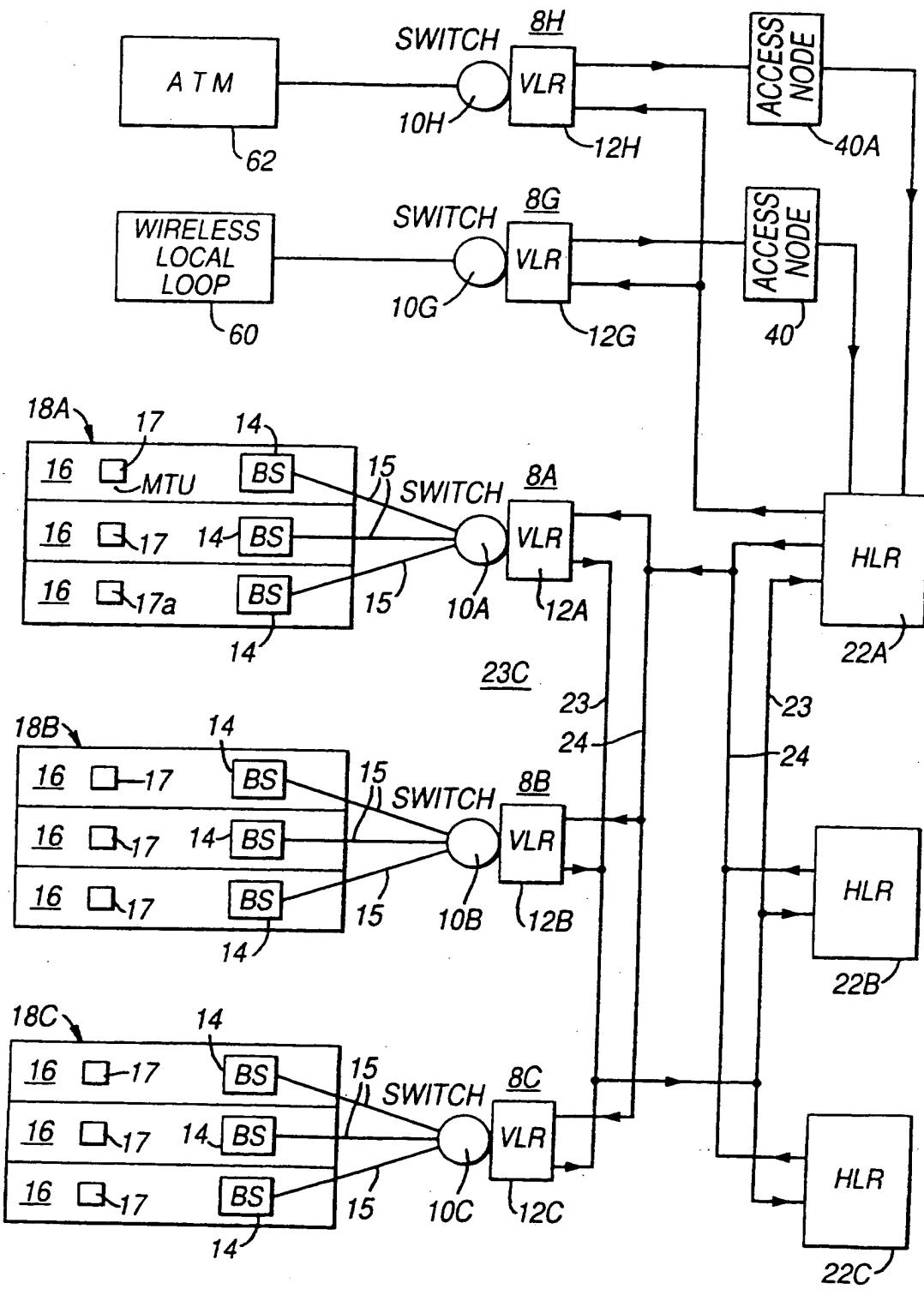


Fig. 3

4/4

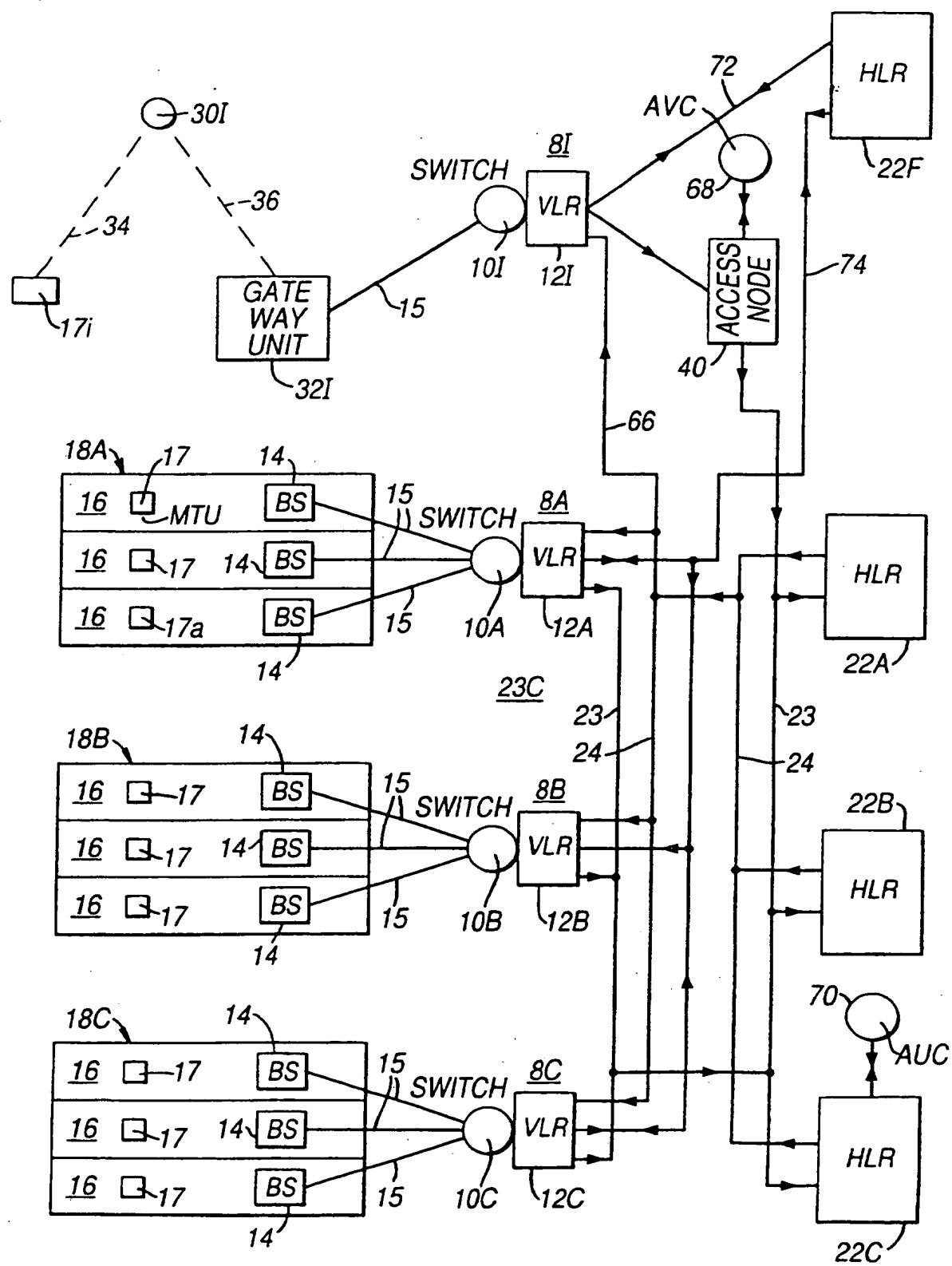


Fig. 4

TELECOMMUNICATION ACCESS SYSTEMS AND METHODS

The invention relates to telecommunication access systems and methods. In one particular application, to be described in more detail below, a telecommunication system embodying the invention comprises a GSM cellular telephone network of which some, at least, of the subscribers can also make and receive calls via satellite (e.g. when they are temporarily out of range of the GSM network). However, the invention is not limited to such applications.

According to the invention, there is provided a telecommunications system, comprising: a first network, the first network being in the form of a cellular telecommunications network defining a plurality of local areas and having a plurality of subscribers to each of which telecommunications service is provided via that subscriber's mobile telecommunications unit when registered as being in one of the areas; main storage means for storing details of the subscribers to the first network and identifying the local area (if any) in which each subscriber is temporarily registered; local storage means responsive to a registration request from the mobile

telecommunications unit of one of the subscribers in one of the local areas for obtaining that subscriber's details from the main storage means and for temporarily storing them with reference to that area thereby to register that mobile telecommunications unit and to enable it to make and receive calls via the first network; a second network providing a predetermined service to its subscribers, at least one of those subscribers (a "dual-mode subscriber") also being a subscriber to the first network, the second network only providing a service to its subscribers when they have been registered in the second network; and access means interposed between the second network and the main storage means for receiving registration requests from subscribers to the second network, and for verifying whether such subscribers are dual-mode subscribers to enable such dual-mode subscribers to be registered in the second network.

According to the invention, there is also provided a telecommunications system, comprising a cellular telephone network defining a plurality of local areas and having a plurality of subscribers capable of making and receiving calls via the network when their mobile telecommunications units are registered as being in one of the local areas; a satellite telecommunications network defining an area and having a

plurality of subscribers capable of making and receiving calls via satellite when their mobile telecommunications units are registered as being in the area of the satellite network, at least some of the subscribers to the satellite network being dual-mode subscribers who are also subscribers to the cellular network; the cellular network comprising main storage means for storing details of the subscribers to that network and identifying the local area (if any) in which each subscriber is temporarily registered, and local storage means responsive to a registration request from a mobile telecommunications unit of a subscriber to the first network in one of the local areas thereof for obtaining that subscriber's details from the main storage means and temporarily storing them with reference to that area, whereby to enable calls to be routed to and from that mobile telecommunications unit; the satellite telecommunications network comprising local storage means responsive to a registration request from a mobile telecommunications unit of a subscriber present in the area of the satellite network to request details of that subscriber from the main storage means of the first network via access means, the access means being separate from the main storage means of the first network and being programmed to pass such requests to the main storage means only after a verification process carried out by the access means has

verified the subscriber as a dual-mode subscriber, whereby the main storage means is not required itself to carry out such verification.

According to the invention, there is further provided a telecommunications system, comprising: at least two cellular telecommunication networks each defining a plurality of local areas, each network having respective main storage means for storing details of the subscribers to the respective network and identifying the local area (if any) in which each subscriber is temporarily registered, each network having local storage means responsive to a registration request from a mobile telecommunications unit of a subscriber (to either one of the networks) temporarily located in one of its local areas for requesting that subscriber's details from the respective main storage means storing those details and for temporarily storing them in the local storage means by reference to the said area, whereby to enable calls to be routed to and from that subscriber, the registration requests from the local storage means of one of the networks being passed to the main storage means of the other network through access means separate from the main storage means, the access means being operative to carry out a verification process to verify whether subscribers to the other

network are permitted to make and receive calls while in the said one network.

According to the invention, there is yet further provided a telecommunications system, comprising: a cellular telecommunications network defining a plurality of local areas, main storage means for storing details of subscribers to the network, local storage means responsive to a registration request from a mobile telecommunications unit of one of the subscribers and present in one of the local areas and operative in response thereto to obtain that subscriber's details from the main storage means and to store them temporarily in the local storage means by reference to that area whereby to enable calls to be made by that subscriber, the identity of the local area being recorded in the main storage means with reference to that subscriber to enable calls to be made to that subscriber; and a separate telecommunications network having a plurality of dispersed telecommunications units which can be activated by at least some ("dual-mode subscribers") of the subscribers to the cellular telecommunications network to make and receive calls, the separate telecommunications network including local storage means operative to generate a registration request in response to activation of one of the dispersed telecommunications units by

one of the subscribers to the cellular telecommunications network, and access means for receiving such registration requests and for carrying out a verification process to verify whether the subscriber is a dual-mode subscriber and for passing only verified registration requests to the main storage means, whereby that subscriber's details are obtained from the main storage means, and details of the activated dispersed telecommunications unit are recorded in relation to that subscriber and are passed to the local storage means, enable calls for that subscriber being routed to and from that dispersed telecommunications unit otherwise than through the access means.

According to the invention, there is still further provided a telecommunications system, comprising: a cellular telecommunications network defining a plurality of local areas and having a plurality of subscribers to each of which telecommunications services are provided by that subscriber's mobile telecommunications unit when registered in one of the areas, main storage means for storing details of the subscribers to the network and identifying the local area (if any) in which each subscriber is temporarily registered, local storage means responsive to a registration request from the mobile telecommunications unit of one of the subscribers when activated

in one of the local areas for obtaining that subscriber's details from the main storage means and for temporarily storing them with reference to that area thereby to register that mobile telecommunications unit and to enable it to make and receive calls via the network; a banking service provision terminal capable of being activated by subscribers to the cellular telecommunications network for providing a predetermined banking service to those subscribers ("dual-mode subscribers") also subscribing to the banking service, local storage means associated with the terminal and responsive to activation of the terminal by one of the subscribers to generate a registration request; and access means separate from the main storage means of the cellular telecommunications network and connected to receive registration requests from the local storage means associated with the terminal and to carry out a verification process to verify whether they originate from dual-mode subscribers, the access means being operative in response to verified registration requests to enable provision of the banking service to that subscriber.

According to the invention, there is also provided an access unit for receiving registration requests from mobile telecommunications units of subscribers to a satellite

telecommunications network, comprising means for identifying such requests from particular ones of the subscribers ("dual-mode subscribers") who are also subscribers to a predetermined cellular telecommunications network, and means for passing identified registration requests from dual-mode subscribers, only, to main storage means of the cellular telecommunications network for registration there, the access unit being separate from the networks.

According to the invention, there is further provided an access unit for receiving registration requests from certain subscribers ("dual-mode subscribers") to a service-providing network who are also subscribers to a cellular telecommunications network, comprising means for receiving registration requests by subscribers requesting provision of the service in the service-providing network, means for distinguishing the requests from dual-mode subscribers, and means passing only such distinguished requests to the cellular telecommunications network for registration there, the cellular telecommunications network responding by providing details of the respective dual-mode subscribers to the service-providing network to enable it to provide the service to them.

According to the invention, there is still further provided a method of providing a predetermined service to certain subscribers ("dual-mode subscribers") to a service-providing network who are also subscribers to a cellular telecommunications network, in which registration requests by subscribers requesting provision of the service in the service-providing network are first checked to distinguish those requests from dual-mode subscribers, and only such distinguished requests are passed to the cellular telecommunications network for registration there, the cellular telecommunications network responding by providing details of the respective dual-mode subscribers to the service-providing network to enable it to provide the service to them.

Telecommunication systems embodying the invention and telecommunication methods according to the invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a schematic diagram of one of the systems comprising GSM cellular telecommunications networks associated with a satellite personal communications network;

Figure 2 is a schematic diagram of another of the systems

comprising a GSM cellular telecommunications network arrangement having the facility for applying restrictions on the roaming capabilities of certain subscribers;

Figure 3 is a schematic diagram of a further one of the systems comprising a GSM cellular telecommunications network in which certain subscribers may have the facility to make and receive calls via a wireless local loop network and/or the facility of using certain banking services; and

Figure 4 corresponds to Figure 1 but shows a cellular network operating to the IS-41 standard instead of to the GSM standard.

As shown in Figure 1, a GSM cellular telecommunications network arrangement comprises a number of mobile switching centres (MSC) 8A, 8B, 8C. Each comprises a respective switch 10A, 10B, 10C which is associated with a respective Visitor Location Register (VLR) 12A, 12B, 12C. Each MSC controls a number of base station subsystems (BSS) 14 to each of which it is connected by landline or by radio link 15. Each BSS station 14 transmits and receives radio signals over a respective geographical area or cell 16 in which mobile telecommunication units (MTUs) 17 (mobile or portable telephones, for example) may be located. In the

following description and in the drawings, some of the MTUs are provided with an additional reference letter (e.g. MTU 17a); this is simply to aid the explanation and such MTUs are the same as the others. The BSSs 14 controlled by a particular MSC 8A, 8B, 8C may cover a total area 18A, 18B, 18C corresponding to part of the geographical area of a particular country, or even the whole country.

In a GSM network, each subscriber to the network is issued with a smart card (SIM) which carries certain information relating to and identifying that subscriber. The subscriber uses the SIM to activate an MTU 17 (for the purposes of making and receiving calls, in a manner to be explained) and that MTU 17 then becomes identified by the SIM as being used by that particular subscriber. In principle, of course, the subscriber can activate any suitable MTU 17 by means of the SIM card. Therefore, references in this specification to a particular subscriber's MTU are references to any MTU when activated by that subscriber's SIM.

Part of the data stored on the SIM is the subscriber's International Mobile Subscriber Identification number (IMSI) which identifies the subscriber and the network to which he

subscribes.

When an MTU 17 (e.g. MTU 17a) is rendered active by insertion of a particular subscriber's SIM and powered up, it will establish radio contact with (normally) the nearest BSS 14, assuming that one is in range, and will transmit the subscriber's IMSI to that BSS. The BSS 14 will transmit corresponding signals identifying the subscriber to the corresponding MSC, such as MSC 8A in this example. The MSC 8A then carries out an interrogation process to check if the subscriber details corresponding to MTU 17a are stored in the VLR 12A. It will initially be assumed that they are not stored there; for example, the subscriber and his MTU 17a may have moved into the area 18A from another area (which may be located in the same or a different country).

The GSM network also includes a number of Home Location Registers (HLRs) 22A, 22B, 22C... . In general, each HLR will correspond to a particular network operator; for example, if there is a single GSM network operator for a particular country, there may be a single HLR corresponding to that country (but may be more than one). Each subscriber's details, will be registered in a particular one of the HLRs 22A, 22B, 22C..., according to the identity of the network operator with which the subscriber is

registered. Such details will include the subscriber's IMSI, his public telephone number, information for use for authentication purposes, billing information, and information identifying the extent of the subscriber's subscription - in particular, whether the subscriber is permitted to roam (that is, make or receive calls via networks outside the subscriber's home country) or whether the subscriber may only use his MTU in his home country.

The VLR 12A (in the example being considered) therefore signals to the appropriate one of the HLRs 22A, 22B, 22C... (according to the subscriber's home network as identified by his IMSI) searching for the particular subscriber's details. Such signals are passed on a suitable landline or radio channel indicated at 23 (e.g. over a public network). When the subscriber's details have been located in the appropriate HLR, the HLR will first check that the subscriber has a current subscription. It will then initiate an authentication process. This involves the sending of "challenge" and "response" data back to VLR 12A (over the public link 23). This data causes MSC 8A to send "challenge" data to MS 17a (via the appropriate BSS 14) which requires the MS 17a to produce a particular "response" which is derived by its SIM according to a particular encryption algorithm stored in the SIM. This response is passed back by the BSS to MSC 8A which

compares it with the "response" data provided by the HLR. If agreement exists, the MS 17a is regarded as authenticated and this fact is signalled back to the HLR over link 23. The HLR responds by sending back to VLR 12A details of the subscriber's entitlement to service - in particular, whether the subscription permits the particular subscriber to operate within the particular area 18A; in other words, if area 18A is outside the subscriber's home country it will check whether or not the particular subscriber is permitted to roam. If the subscriber is not permitted to roam and is attempting to register within an area outside the areas controlled by the subscriber's home network operator, then the subscriber will not be permitted to register. Otherwise, though, the subscriber's details will be stored in VLR 12A. In addition, the HLR stores the subscriber's current location. If and when the subscriber wishes to make a call, while located in the area 18A, the VLR 12A has all the necessary information to enable such a call to be set up. Such calls will be set up through the BSS 14 of the particular cell in which the subscriber's MTU 17a is located. If the subscriber moves to a different cell within the area 18A, the call is "handed over" to the base station of the new cell.

If the subscriber's MTU 17a moves into a different area, e.g.

area 18B or 18C, and attempts to register in a cell of that area, then the registration and authentication process described above will be repeated by the VLR of the new area.

As noted above, the subscriber's HLR stores the subscriber's current location (that is, the identity of the VLR corresponding to the area 18A, 18B or 18C in which the MTU is located). In this way, the HLR can correctly route incoming calls to the subscriber's MTU.

The areas 18A, 18B, 18C will not cover all geographical areas. Even in countries where there are very well established GSM networks, there will be geographical locations where an MTU will be outside radio contact of any base station; such areas may be remote rural areas, for example, or areas where the local conditions are not conducive to satisfactory radio communication with a terrestrial base station. There will also, of course, be large geographical regions in the world, whole countries or groups of countries for example, where there is no GSM network at all. In order to provide substantially complete geographical coverage, over a substantial part of the world for example, it is therefore proposed to provide supplementary coverage by means of satellite. Subscribers will be dual-mode MTUs which (when

activated by the subscriber's SIM) are capable of operating as normal GSM MTUs (as described above) but which are also capable of making and receiving telecommunication calls via one of these satellites. This is indicated diagrammatically in Figure 1 which shows a satellite 30. This is in radio contact with a gateway unit 32 which is in turn connected to an MSC 8D associated with a switch 10D and a corresponding VLR 12D. As will be explained, the MSC 8D operates in generally similar manner to the MSC's 8A, 8B, 8C. The gateway unit 32 corresponds, at least functionally, with one of the BSSs 14. A dual-mode MTU 17d, terrestrially located within the geographical area or "footprint" of radio coverage provided by the satellite 30, will make and receive calls via radio link 34 between itself and the satellite 30 and radio link 36 between the satellite 30 and the gateway unit 32. The footprint of satellite 30 will be very much larger than each of the areas 18A, 18B, 18C and may cover a large geographical region encompassing several countries. When the MTU 17d is powered up within the footprint area of satellite 30, but outside the range of any terrestrial base station 14, its signals will be detected by the gateway unit 32 via the satellite 30 and passed to the MSC 8D on a link 15. In substantially the same manner as already described, the MSC 8D will now address its VLR 12D for details of the subscriber. Assuming, in the general

case, that such details are not present in VLR 12D, the VLR 12D will now address the appropriate HLR 22A,22B,22C..., as identified by the subscriber's IMSI, to locate the subscriber's details. This process will be described in more detail below. In principle, though, it needs to perform the same functions as already described for a subscriber 17a registering within the area 18A. Thus, an authentication process must be carried out so that the HLR can then record the subscriber's current location and provide VLR 12D with the necessary subscriber information to enable the MTU 17d to make and receive calls via satellite 30.

As stated above, MTUs such as MTUs 17d, capable of making and receiving calls via satellite as well as via terrestrial base stations 14, will need a dual-mode capability. They will also, of course, need to be authorised to make and receive calls not only via terrestrial base stations but also via satellite for which, in the general case, there will be additional charges. It is therefore necessary for the system to be able to identify that a subscriber registering via satellite is in fact properly authorised to make and receive calls in that mode.

In order to provide a practical implementation of a facility enabling dual-mode MTUs to operate, it is clearly necessary that

such a facility can easily be integrated with existing GSM networks. For commercial reasons, operators of satellite communication networks will wish to conclude arrangements with as large a number of GSM network operators as possible, so that they can increase the attractiveness of dual-mode MTUs, and the corresponding dual-mode subscriptions, to potential subscribers. Such potential subscribers will want to know that, wherever possible, their MTUs can make and receive calls via terrestrial networks, only making calls via satellite where terrestrially connected calls are not possible. In this way, their usage costs will be reduced. As far as terrestrial GSM network operators are concerned, though, the number of subscribers wishing to have dual mode capability will be quite small - and likely to be a very small proportion of their total number of subscribers. For this reason, at least in the initial stages of the introduction of dual-mode capability, terrestrial GSM network operators will be very reluctant to implement any modifications to their HLRs, or to other parts of their system such as signalling, simply in order to accommodate a number of dual-mode subscribers which may be very small in relative terms. This problem is particularly relevant to verification dual-mode MTUs. Thus, although it may be a simple matter to arrange for each dual-mode MTU (e.g. MTU 17d) to include a suitable data "flag" in its signalling data,

to indicate that it is in fact a dual-mode MTU, the system must be able to respond to this flag and must have the capability of checking whether the subscriber for that MTU in fact has a current dual-mode subscription permitting calls to be made via satellite. In order for HLRs to have this capability, HLRs in existing use in current GSM networks would require modification and/or modification to network signalling standards would also be required. For the reasons explained above, this requirement is unacceptable.

In order to deal with this problem, therefore, VLR 12D does not communicate directly with the HLRs 22A, 22B, 22C but via an access node 40 by means of a link 42D. The access node 40 may be provided by and controlled by the operator of the satellite system.

When the dual-mode MTU 17d is powered up (and activated by a particular subscriber's SIM), its registration request, including its IMSI, is passed by VLR 12D to the access node 40. The access node is arranged to carry out a check on the IMSI to establish whether or not the particular MTU 17d is being used by a subscriber having a current subscription permitting access by satellite. For this purpose, the access node 40 is provided by

the satellite network operator with all necessary up to date information to enable the access node 40 to carry out the verification process.

Assuming that the verification process is carried out satisfactorily, the access node 40 then addresses the registration request to the appropriate HLR 22A,22B,22C (in accordance with the information in the IMSI). The HLR now responds in the same way as though the request had been received from one of the VLRs 12A,12B,12C connected to terrestrial base stations. The HLR does not need to respond, or to be able to respond, to the data flag indicating that the subscriber in this case is a dual-mode subscriber. Because the data transmitted on the link 42D to the access node 40 includes data identifying the VLR 12D, the appropriate HLR containing data relating to the subscriber can return the relevant subscriber information directly to VLR 12D on a link 43 (e.g. a public link), without having to pass this data via the access node 40. The authentication process described above with reference to MTU 17a then takes place in order to register the subscriber with VLR 12D and to enable the appropriate HLR to record the current location of the subscriber's MTU 17d. The access node 40 is not involved in this process, but may act as a transparent relay for the signals.

In any particular geographical region corresponding to the footprint area of a single satellite, which may be a large region covering several countries, there may be only a single gateway unit 32 and the associated MSC 8D. There will thus be a single access node 40. The output of the access node 40 will in this case be connected to the HLRs of all the GSM networks in this region. It will be apparent that the access node 40 does not need to be physically located within the geographical region; it merely needs to be appropriately connected by land line or radio link (e.g. public links) to the MSCs 8D and to all the relevant HLRs. It would therefore be possible for a single access node corresponding to the access node 40 to handle signals received from a number of different MSCs similar to the MSC 8D, each of these MSCs being connected to a gateway unit corresponding to gateway unit 32 and handling calls to and from a respective satellite. In other words, a single access node could handle calls to and from a number of different satellites covering different geographical regions across the world.

In some cases, of course, all or part of the footprint area of a particular satellite may cover a geographical region in which there is no coverage by terrestrial GSM networks at all. Again, though, a dual-mode MTU registering via such a satellite would

be verified and authenticated by the appropriate access node similar to access node 40, and, if verification is established, appropriate signals would be sent to the relevant HLR.

In practice, where an MSC is serving only a satellite gateway unit (that is, it is not also serving a terrestrial base station), the functions of the switch and the VLR may be combined within the gateway unit.

The verification process (to verify that a dual-mode MTU has a current dual-mode capability) carried out by the access node 40 would of course be controlled by information provided by the satellite system operator. This operator would forward the information in any suitable form to an administration centre which would program the access node accordingly. It would be possible for a satellite operator to control the extent of use permitted to a particular dual-mode subscriber when operating via satellite. Thus, such a subscriber might be limited to use of the MTU (in the satellite mode) in only one or selected ones of the footprint areas of the satellites, according to the level of subscription paid; and it would also be possible, of course, to vary the level of call charges according to the particular footprint area. Each MSC will handle calls to and from only a

particular satellite. The identity of the MSC is signalled to the access node 40 on the link 42, and the access node can therefore be programmed to allow a particular subscriber to make and receive calls only via particular MSCs.

Figure 1 shows how the MSC 8D can communicate directly with one HLR, HLR 22D. It is assumed in this case that the HLR 22D has been modified, as compared with standard GSM HLRs, so as to be able to detect registration requests from dual-mode subscribers and also to carry out the necessary verification and process to check in particular that such a subscriber has a current subscription permitting satellite calls. In this case, therefore, there is no need for the signals from the VLR 12D to pass through the access node 40. HLR 22D is also connected to the VLRs 12A, 12B and 12C by connections indicated at 44. HLR 22D would of course be involved, as well, in authenticating such a subscriber in the manner already explained.

Figure 2 shows a modified system and items in Figure 2 corresponding to those in Figure 1 are correspondingly referenced.

In the system of Figure 2, it is assumed by way of example that

the MSCs 8A, 8B and 8C are connected to terrestrial BSSs 14 defining cells within a particular geographical region, such as in a particular European country or distributed among several European countries (obviously, there would be more units and more BSSs than illustrated in order to cover such a region). In other words, areas 18A, 18B and 18C make up this European region. HLRs 22A, 22B and 22C are the HLRs for the GSM network operators within this region. It will also be assumed that MSCs 8E and 8F are controlling base stations in a different geographical region, such as in the Far East for example. This region is therefore made up by areas 18E and 18F. The corresponding HLR for the network operators in this Far East region is shown at 22E (there may of course be more than one).

An MTU 17 in any of the cells in areas 18A, 18B and 18C (the European region) registers into the system in the manner described with reference to MTU 17a in Figure 1. Thus the appropriate VLR 12A, 12B, 12C communicates information received from the MTU 17 to the appropriate HLR to locate the relevant data corresponding to that MTU, and this data is then used to authenticate the subscriber whereafter the location of the MTU is stored in the HLR and relevant information is also stored in the VLR for use when the MTU wishes to make or receive calls.

Similarly, a subscriber's MTU 17 in a cell in the Far East region 18E, 18F registers into the system in the same way, by means of signals sent by VLR 12E or 12F to HLR 22E and in the reverse direction on channels 45 and 46. In addition, VLRs 12E and 12F are directly connected to HLRs 22B and 22C (but not to HLR 22A) by channels 48 and 50, and VLRs 12A, 12B and 12C are directly connected by channels 52 and 54 to HLR 22E. In principle, therefore, subscribers in the European region can roam into the Far East region and subscribers in the Far East region can roam into the networks in the European region corresponding to HLRs 22B and 22C. Obviously, though, any such roaming subscriber would be subjected to check in the appropriate HLR, when registering, to ensure that a current roaming entitlement existed.

However, by means of an access node 40, similar in functional terms to the access node 40 of Figure 1, the network operator in the European region corresponding to HLR 22A can apply certain controls to subscriber roaming without the necessity for any modification to the HLR or to signalling in the system. Thus, as shown in Figure 2, signals to HLR 22A from VLRs 12E and 12F are routed through the access node 40 via channel 56. In this way, the network operator corresponding to HLR 22A can apply

geographical control to the roaming of its subscribers in the Far East networks. Thus, a subscriber to the network corresponding to HLR 22A can be given a roaming capability enabling that subscriber to make and receive calls not only in the relevant home network but also in the other networks in the European regions. However, all registration requests from the MTUs of subscribers to the network of HLR 22A while roaming in the Far East region are routed to HLR 22A via access node 40. The network operator can arrange for the access node 40 to detect any registration attempts by any such "roaming-limited" subscriber while in the Far East region and to reject such registration attempts. Registration attempts by other subscribers will not be blocked by the access node. Obviously, the access node 40, or more than one similar access node, can be re-arranged or arranged so as to apply other controls on roaming. The access node otherwise operates in the same way as described with reference to Figure 1.

In Figure 3, items corresponding to those in the other Figures are similarly referenced.

As in the other Figures, a GSM network comprises MSCs 8A, 8B, 8C, serving base stations 14 which define cells 16. The operations

carried out when an MTU 17 in one of the cells is powered on is exactly as already described. In addition, however, the system of Figure 3 envisages two further possibilities.

In a first one of these possibilities, it is envisaged that a subscriber to one of the GSM networks (in this example, assumed to be the network operated by the network operator controlling HLR 22A) has a dual-mode subscription which not only enables calls to be made via a normal GSM handset 17 but also via a telephone in a "wireless local loop" network. In certain countries, fixed telephone systems are being implemented or expanded using radio links between local exchanges and the fixed telephones of local subscribers. If such a country or region of that country does not have a GSM cellular telephone network, it would be desirable for a visiting GSM subscriber to be able to make and receive calls via a fixed telephone forming part of a wireless local loop network. Even in cases where calls might in principle be possible via satellite link (in the manner described with reference to Figure 1 for example), this may not be locally possible; in particular, calls via satellite are normally not possible within a building. It is therefore envisaged that an arrangement could be concluded between the operator of a wireless local loop system and a GSM network operator which would permit

certain subscribers, who would have registered for the facility and have paid an appropriate additional subscription, to make and receive calls via such a wireless local loop system. As shown in Figure 3, an input unit 60 would be provided on or associated with the fixed telephones in such wireless local loop system. If a subscriber wished to make or receive calls via the wireless local loop system, the SIM of the subscriber would be inserted into the input unit 60. This would cause signals relating to the subscriber's IMSI, together with the telephone number of the fixed telephone, to be transmitted to an MSC 8G. In principle, the VLR 12G now has to access the subscriber's HLR in order to carry out registration. As shown in Figure 3, this process is carried out via an access node 40, corresponding in principle to the access nodes 40 of Figures 1 and 2. It is therefore the access node 40 in Figure 3 which checks the subscriber's details received from the MSC 8G to verify whether the subscriber is currently authorised in a dual-mode capacity which enables him to make and receive calls via the wireless local loop. The access node 40 would of course be appropriately programmed, to enable this check to be carried out, by information provided by the wireless local loop operator and/or the GSM operator. Assuming that the check was satisfactorily performed, the access node 40 passes the subscriber's information to HLR 22A together.

of course, with the number of the fixed telephone in the wireless local loop network and an identification of the MSC 8G. HLR 22A can now initiate an authentication process similar to that described with reference to MTU 17d in Figure 1 and, if satisfactorily completed, can then record the current location of the subscriber. In addition, the necessary information relating to that subscriber is stored in MSC 8G. In this way, again, the use of the access node 40 enables a dual-mode capacity to be supported without any necessity to alter the construction or operation of any of the HLR's.

If of course the access node 40 determines that the subscriber does not have, or does not currently have, the appropriate dual-mode subscription, then the subscriber's attempt to register in the wireless local loop system is refused.

In the example considered, it was assumed that only the network operator associated with HLR 22A would have concluded an arrangement with the wireless local loop operator. Of course, others of the GSM operators might also have concluded such agreements, in which case output signals from access node 40 would also be fed to their HLRs.

Because the appropriate HLR has received information relating to the number of the fixed telephone in the wireless local loop, incoming calls to that subscriber can be correctly routed to that telephone. As before, the access node is only involved in the verification process.

Figure 3 also illustrates another possibility for dual-mode subscription. In this example, subscribers may have a dual-mode subscription enabling them to use their SIMs for banking purposes, such as for obtaining account or similar information and, possibly, for obtaining cash. As shown in Figure 3, a suitable card-operated terminal such as a cash dispenser (ATM) 62 is provided and linked to an MSC 8H. A subscriber having the appropriate dual-mode capability and wishing to obtain account information or cash, inserts the SIM into the ATM 62 and may also input other information such as a PIN and an indication of the amount of cash required. The MSC 8H receives this information, including the subscriber's IMSI, from the ATM 62 and transmits it to the subscriber's corresponding HLR (in this example, assumed to be HLR 22A) via an access node 40A corresponding generally to the access nodes 40 already referred to; the transmitted information includes identification of the MSC 8H. The access node 40A is pre-programmed to check the subscriber's

data received from the MSC 8H to ensure that the subscriber's current subscription allows the subscriber to have access to the banking service requested. If this check is carried out successfully, the access unit 40A informs HLR 22A accordingly. The HLR 22A then notes the location of the subscriber and then initiates an authentication process similar to that described above with reference to MTU 17a in Figure 1. Again, therefore, this process can be carried out without requiring any modification to the HLR or to the signalling within the system.

Figure 4 shows another embodiment, where a cellular telephone system is operating to the IS-41 standard, rather than to the GSM standard (as in the case of Figures 1, 2 and 3).

In Figure 4, MSCs 8A, 8B and 8C are functionally similar to the corresponding units in the other Figures but operate according to IS-41. These MSCs control base stations 14 defining cells 16 in which MTUs 17 may be present. The process by which each MTU registers itself with the network when powered up is generally similar to that described for the GSM networks and with reference to Figures 1, 2 and 3. However, the MTUs are not activated by SIMs. Each MTU is programmed as belonging to a particular subscriber. When such an MTU is powered up, this is noted by the

appropriate BSS 14 and signals identifying the MTU (similar to the IMSI in GSM networks) are transmitted to the switch of the corresponding MSC 8A, 8B or 8C. Assuming that the subscriber is not currently registered in the corresponding VLR, the VLR seeks this information from the appropriate HLR 22A, 22B, 22C (as identified in the MTU's registration request). The HLR with which the subscriber is registered notes the current location of the subscriber, carries out at least a partial authentication process and transmits subscriber details back to the correct VLR to enable calls to be routed to and from that subscriber.

Figure 4 also shows how dual-mode subscribers can, where necessary (that is, where they are out of range of a terrestrial base station) make and receive calls via satellite (in generally the same manner as described with reference to Figure 1). As shown, MSC 8I is connected to a gateway unit 32I. Gateway unit 32I monitors calls transmitted to and from satellite 30I.

Dual-mode operation (that is, the possibility that some subscribers may make calls via satellite instead of via a terrestrial base station when the latter is not available) is more complicated where the cellular network is IS-41 based. This is because it is envisaged that subscribers operating in

satellite mode will have to be fully authenticated before they are allowed to operate in the system - that is fully authenticated to the level envisaged and operating in GSM cellular systems, involving the "challenge" and "response" process described above with reference to Figure 1. Currently operative versions of IS-41 (IS-41.A and IS-41.B) do not support such authentication. A more recent version, IS-41.C, does include a form of subscriber authentication, but this version is not yet operative. A future version under discussion, IS-41.D, includes full authentication in generally the same functional manner as in GSM.

In the following description, it will be assumed that HLR 22A and HLR 22B operate according to IS-41.A or IS-41.B, and that HLR 22C operates in accordance with IS-41.C. It will be assumed that MTU 17I is a dual-mode MTU. When it is powered up, its identification signals are passed via a satellite 30I and gateway unit 32I to MSC 8I. Assuming that VLR 12I is not currently storing details of MTU 17I, VLR 12I will access the appropriate HLR 22A, 22B, 22C in the manner generally as described with reference to Figure 1, that is, via access node 40. As described with reference to Figure 1, the access node 40 is programmed with the necessary information to enable it to carry

out a verification process to ensure that MTU 17i is currently permitted to make and receive calls via satellite. Assuming that this verification process is satisfactorily completed, the access node 40 accesses the appropriate HLR 22A,22B,22C to locate the subscriber's details. In this case, though, the access node 40 is also arranged to carry out an additional function - that is, the necessary authentication operation. This can be carried out by an authentication unit 68 associated with the access node 40. Insofar as HLR 22C operates according to IS-41.C, which inherently includes a form of authentication (shown diagrammatically in Figure 4 at 70), this authentication operation carried out by access node 40 may not be necessary if HLR 22C is the subscriber's home network.

In Figure 4, a further HLR 22F is shown. It is assumed that this HLR (like HLR 22D of Figure 1) has been modified, as compared with HLRs 22A,22B and 22C, so as to be able to detect registration requests from dual-mode subscribers and also to carry out the necessary verification process to check that such a subscriber has a current subscription permitting satellite calls. It is also assumed that HLR 22F is operating according to IS-41.D and thus carries out the full authentication process. Therefore, there is no need for the signals to and from VLR 12I

to pass through access node 40 in order to reach HLR 22F; they are passed directly, as shown by the link 72. HLR 22F is connected to the other VLRs by a link 74 for similar purposes.

Authentication unit 68 is programmed to carry out authentication by the "challenge" and "response" method described above with reference to the other Figures. Therefore, in this case the access node 40 enables networks using non-authentication versions of IS-41 to support dual-mode MTUs.

CLAIMS

1. A telecommunications system, comprising: a first network, the first network being in the form of a cellular telecommunications network defining a plurality of local areas and having a plurality of subscribers to each of which telecommunications service is provided via that subscriber's mobile telecommunications unit when registered as being in one of the areas; main storage means for storing details of the subscribers to the first network and identifying the local area (if any) in which each subscriber is temporarily registered; local storage means responsive to a registration request from the mobile telecommunications unit of one of the subscribers in one of the local areas for obtaining that subscriber's details from the main storage means and for temporarily storing them with reference to that area thereby to register that mobile telecommunications unit and to enable it to make and receive calls via the first network; a second network providing a predetermined service to its subscribers, at least one of those subscribers (a "dual-mode subscriber") also being a subscriber to the first network, the second network only providing a service to its subscribers when they have been registered in the second network; and access means interposed between the second network and the main storage means for receiving registration requests

from subscribers to the second network, and for verifying whether such subscribers are dual-mode subscribers to enable such dual-mode subscribers to be registered in the second network.

2. A system according to claim 1, in which the second network is another telecommunications network.

3. A system according to claim 2, in which the second network is a satellite network providing a telecommunications service for its subscribers when registered in the network, the satellite network including local storage means, and in which a dual-mode subscriber is registered in the satellite network by means of details of that subscriber obtained from the main storage means in the first network and for temporarily stored in the local storage means of the satellite network.

4. A system according to claim 2, in which the second network is another cellular telecommunications network defining at least one local area, the dual-mode subscribers comprising those subscribers of the first network who are permitted to make and receive calls via the second network when registered therein.

5. A system according to claim 4, including main storage means

for the second network for storing details of subscribers to the second network and identifying the local area (if any) in which each subscriber is temporarily registered, and local storage means for the second network responsive to a registration request from the mobile telecommunications unit of a subscriber to either of the networks when in the area of the second network for obtaining the subscriber's details from the main storage means for the second network if stored therein and temporarily storing them in the local storage means for the second network to enable calls to be made to and from that mobile telecommunications unit, the local storage means for the second network being responsive to a registration request from a mobile telecommunications unit of a dual-mode subscriber in the local area for the second network for passing that registration request to first-mentioned main storage means via the access means.

6. A telecommunications system according to claim 2, in which the second network is a non-cellular telecommunications network.

7. A system according to claim 6, in which the second network is a wireless local loop network.

8. A system according to claim 1, in which the second network

is a network providing a predetermined banking service.

9. A system according to claim 8, in which the banking service is a banking information or cash withdrawal service.

10. A system according to any preceding claim, in which the first network is a GSM network.

11. A system according to any one of claims 1 to 10, in which mobile telecommunications unit is rendered active to produce a registration request by a token identifying that subscriber, and in which each dual-mode subscriber registers in the second network by means of that token.

12. A system according to claim 11, in which each token is a smart card.

13. A system according to any preceding claim, in which in response to a registration request an authentication process is carried out to authenticate the subscriber making the request, the authentication process when involving a subscriber to the second network being carried otherwise than by the access means.

14. A system according to any one of claims 1 to 9, in which the first network is a network according to IS-41, and in which the access means provides at least partial authentication of subscribers making registration requests, such authentication involving challenge and response and being additional to the verification whether such subscribers are dual-mode subscribers.

15. A telecommunications system, comprising a cellular telephone network defining a plurality of local areas and having a plurality of subscribers capable of making and receiving calls via the network when their mobile telecommunications units are registered as being in one of the local areas; a satellite telecommunications network defining an area and having a plurality of subscribers capable of making and receiving calls via satellite when their mobile telecommunications units are registered as being in the area of the satellite network, at least some of the subscribers to the satellite network being dual-mode subscribers who are also subscribers to the cellular network; the cellular network comprising main storage means for storing details of the subscribers to that network and identifying the local area (if any) in which each subscriber is temporarily registered, and local storage means responsive to a registration request from a mobile telecommunications unit of a

subscriber to the first network in one of the local areas thereof for obtaining that subscriber's details from the main storage means and temporarily storing them with reference to that area, whereby to enable calls to be routed to and from that mobile telecommunications unit; the satellite telecommunications network comprising local storage means responsive to a registration request from a mobile telecommunications unit of a subscriber present in the area of the satellite network to request details of that subscriber from the main storage means of the first network via access means, the access means being separate from the main storage means of the first network and being programmed to pass such requests to the main storage means only after a verification process carried out by the access means has verified the subscriber as a dual-mode subscriber, whereby the main storage means is not required itself to carry out such verification.

16. A system according to claim 15, in which the main storage means of the first network passes details of the dual-mode subscriber to the local storage means of the satellite network without their being affected by the access means.

17. A system according to claim 15 or 16, in which the satellite

network includes its own main storage means for storing details of at least some of its subscribers, and in which the local storage means of the satellite network responds to a registration request from one such subscriber by obtaining the subscriber's details from that main storage means and temporarily storing them.

18. A system according to any one of claims 15 to 17, in which the cellular telecommunications network is a GSM network.

19. A system according to any one of claims 15 to 18, in which each subscriber's mobile telecommunications unit is rendered active to produce a registration request by a token identifying that subscriber, and in which each dual-mode subscriber registers in the satellite telecommunications network by means of that token.

20. A system according to claim 19, in which each token is a smart card.

21. A system according to any one of claims 15 to 20, in which a registration request from a subscriber initiates an authentication process involving "challenge" and "response", this

authentication process being additional to the verification process and being carried out otherwise than by the access means.

22. A system according to claim 21, in which the cellular telecommunications network is a network operating according to IS-41.

23. A telecommunications system, comprising: at least two cellular telecommunication networks each defining a plurality of local areas, each network having respective main storage means for storing details of the subscribers to the respective network and identifying the local area (if any) in which each subscriber is temporarily registered, each network having local storage means responsive to a registration request from a mobile telecommunications unit of a subscriber (to either one of the networks) temporarily located in one of its local areas for requesting that subscriber's details from the respective main storage means storing those details and for temporarily storing them in the local storage means by reference to the said area, whereby to enable calls to be routed to and from that subscriber, the registration requests from the local storage means of one of the networks being passed to the main storage means of the other network through access means separate from the main storage

means, the access means being operative to carry out a verification process to verify whether subscribers to the other network are permitted to make and receive calls while in the said one network.

24. A system according to claim 23, in which the networks are GSM networks.

25. A system according to claim 23 or 24, in which each subscriber's mobile telecommunications unit is rendered active to produce a registration request by a token identifying that subscriber.

26. A system according to claim 25, in which each token is a smart card.

27. A system according to any one of claims 23 to 26, in which a registration request from a subscriber initiates an authentication process involving "challenge" and "response", this authentication process being additional to the verification process and being carried out otherwise than by the access means.

28. A telecommunications system, comprising: a cellular

telecommunications network defining a plurality of local areas, main storage means for storing details of subscribers to the network, local storage means responsive to a registration request from a mobile telecommunications unit of one of the subscribers and present in one of the local areas and operative in response thereto to obtain that subscriber's details from the main storage means and to store them temporarily in the local storage means by reference to that area whereby to enable calls to be made by that subscriber, the identity of the local area being recorded in the main storage means with reference to that subscriber to enable calls to be made to that subscriber; and a separate telecommunications network having a plurality of dispersed telecommunications units which can be activated by at least some ("dual-mode subscribers") of the subscribers to the cellular telecommunications network to make and receive calls, the separate telecommunications network including local storage means operative to generate a registration request in response to activation of one of the dispersed telecommunications units by one of the subscribers to the cellular telecommunications network, and access means for receiving such registration requests and for carrying out a verification process to verify whether the subscriber is a dual-mode subscriber and for passing only verified registration requests to the main storage means,

whereby that subscriber's details are obtained from the main storage means, and details of the activated dispersed telecommunications unit are recorded in relation to that subscriber and are passed to the local storage means, enable calls for that subscriber being routed to and from that dispersed telecommunications unit otherwise than through the access means.

29. A system according to claim 28, in which the dispersed telecommunications units are part of a wireless local loop system.

30. A system according to claim 28 or 29, in which each dispersed telecommunications unit can only be activated in relation to a respective subscriber by means of a token particular to that subscriber.

31. A system according to any one of claims 28 go 30, in which a registration request from a subscriber initiates an authentication process involving "challenge" and "response", this authentication process being additional to the verification process and being carried out otherwise than by the access means.

32. A telecommunications system, comprising: a cellular

telecommunications network defining a plurality of local areas and having a plurality of subscribers to each of which telecommunications services are provided by that subscriber's mobile telecommunications unit when registered in one of the areas, main storage means for storing details of the subscribers to the network and identifying the local area (if any) in which each subscriber is temporarily registered, local storage means responsive to a registration request from the mobile telecommunications unit of one of the subscribers when activated in one of the local areas for obtaining that subscriber's details from the main storage means and for temporarily storing them with reference to that area thereby to register that mobile telecommunications unit and to enable it to make and receive calls via the network; a banking service provision terminal capable of being activated by subscribers to the cellular telecommunications network for providing a predetermined banking service to those subscribers ("dual-mode subscribers") also subscribing to the banking service, local storage means associated with the terminal and responsive to activation of the terminal by one of the subscribers to generate a registration request; and access means separate from the main storage means of the cellular telecommunications network and connected to receive registration requests from the local storage means

associated with the terminal and to carry out a verification process to verify whether they originate from dual-mode subscribers, the access means being operative in response to verified registration requests to enable provision of the banking service to that subscriber.

33. A system according to claim 32, in which the terminal comprises cash dispensing means.

34. A system according to claim 32 or 33, in which each subscriber's mobile telecommunications unit is activated by a token particular to that subscriber, and in which banking terminal is also activated by that token.

35. A system according to any one of claims 32 to 34, in which a registration request from a subscriber initiates an authentication process involving "challenge" and "response", this authentication process being additional to the verification process and being carried out otherwise than by the access means.

36. An access unit for receiving registration requests from mobile telecommunications units of subscribers to a satellite telecommunications network, comprising means for identifying such

requests from particular ones of the subscribers ("dual-mode subscribers") who are also subscribers to a predetermined cellular telecommunications network, and means for passing identified registration requests from dual-mode subscribers, only, to main storage means of the cellular telecommunications network for registration there, the access unit being separate from the networks.

37. An access unit for receiving registration requests from certain subscribers ("dual-mode subscribers") to a service-providing network who are also subscribers to a cellular telecommunications network, comprising means for receiving registration requests by subscribers requesting provision of the service in the service-providing network, means for distinguishing the requests from dual-mode subscribers, and means for passing only such distinguished requests to the cellular telecommunications network for registration there, the cellular telecommunications network responding by providing details of the respective dual-mode subscribers to the service-providing network to enable it to provide the service to them.

38. An access unit according to claim 37, in which the service-providing network is a satellite telecommunications network.

39. An access unit according to claim 37, in which the service-providing network is another cellular telecommunications network.

40. An access unit according to claim 37, in which the service-providing network is a wireless local loop network.

41. An access unit according to claim 37, in which the service-providing network is a network providing a banking service.

42. An access unit according to claim 41, in which the banking service is a cash withdrawal service.

43. An access unit according to any one of claims 37 to 42, in which each dual-mode subscriber has a token particular to that subscriber for activating a mobile telecommunications unit in the or the first-mentioned cellular telecommunications network, and in which the same token is used to make a registration request in the service-providing network.

44. A method of providing a predetermined service to certain subscribers ("dual-mode subscribers") to a service-providing network who are also subscribers to a cellular telecommunications network, in which registration requests by subscribers requesting

provision of the service in the service-providing network are first checked to distinguish those requests from dual-mode subscribers, and only such distinguished requests are passed to the cellular telecommunications network for registration there, the cellular telecommunications network responding by providing details of the respective dual-mode subscribers to the service-providing network to enable it to provide the service to them.

45. A method according to claim 44, in which the service-providing network is a satellite telecommunications network.

46. A method according to claim 44, in which the service-providing network is another cellular telecommunications network.

47. A method according to claim 44, in which the service-providing network is a wireless local loop network.

48. A method according to claim 44, in which the service-providing network is a network providing a banking service.

49. A method according to claim 48, in which the banking service is a cash withdrawal service.

50. A method according to any one of claims 44 to 50, in which each dual-mode subscriber has a token particular to that subscriber for activating a mobile telecommunications unit in the or the first-mentioned cellular telecommunications network, and in which the same token is used to make a registration request in the service-providing network.

51. A telecommunications system, substantially as described with reference to Figure 1 of the accompanying drawings.

52. A telecommunications system, substantially as described with reference to Figure 2 of the accompanying drawings.

53. A telecommunications system, substantially as described with reference to Figure 3 of the accompanying drawings.

54. A telecommunications system, substantially as described with reference to Figure 4 of the accompanying drawings.

55. An access unit in a telecommunications system, substantially as described with reference to Figure 1 of the accompanying drawings.

56. An access unit in a telecommunications system, substantially as described with reference to Figure 2 of the accompanying drawings.

57. An access unit in a telecommunications system, substantially as described with reference to Figure 3 of the accompanying drawings.

58. An access unit in a telecommunications system, substantially as described with reference to Figure 4 of the accompanying drawings.

59. A telecommunications method, substantially as described with reference to Figure 1 of the accompanying drawings.

60. A telecommunications method, substantially as described with reference to Figure 2 of the accompanying drawings.

61. A telecommunications method, substantially as described with reference to Figure 3 of the accompanying drawings.

62. A telecommunications method, substantially as described with reference to Figure 4 of the accompanying drawings.



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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4L (LDSC, LDA, LDG, LDSK)

Int Cl (Ed.6): H04Q 7/22, 7/38

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
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